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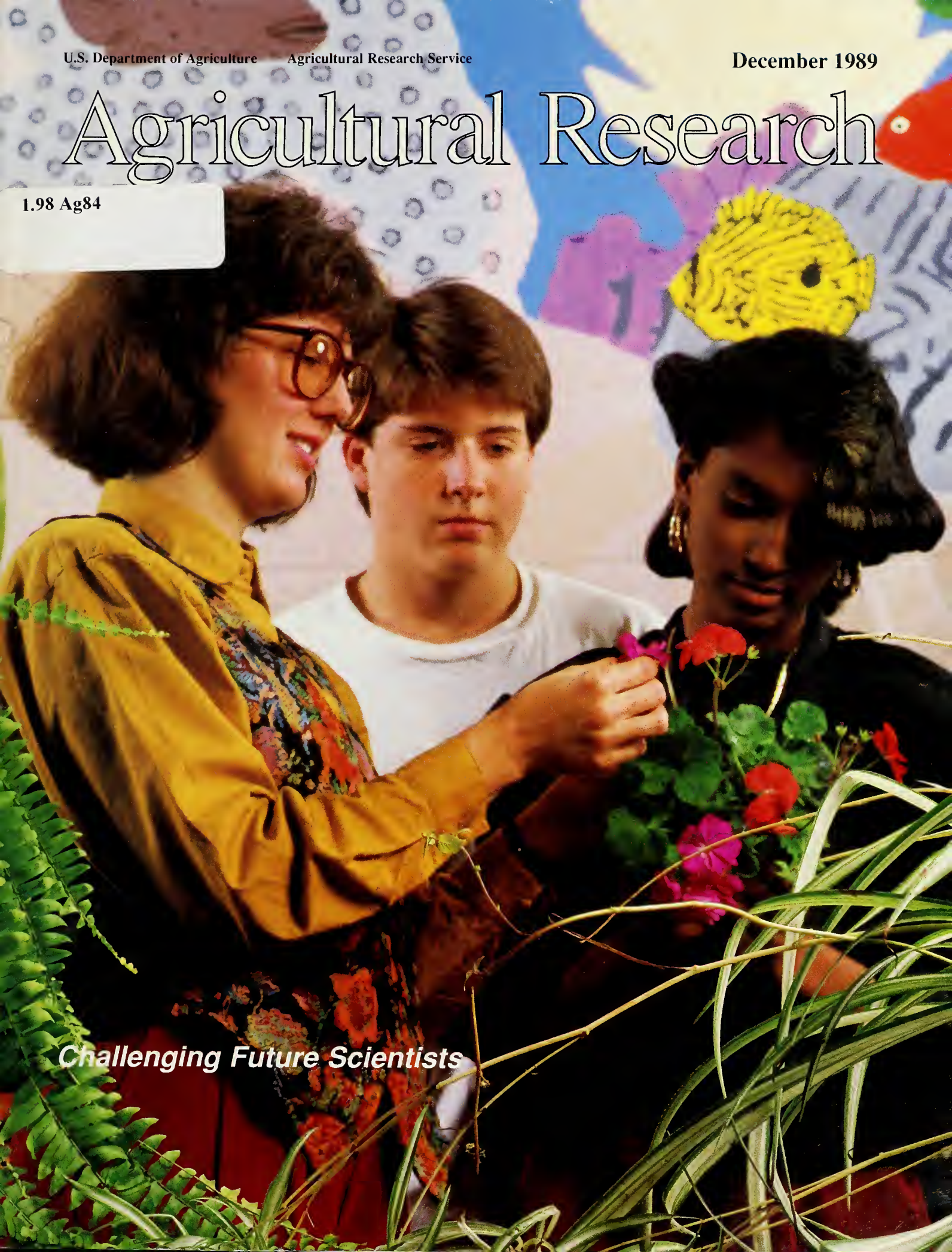

Challenging Future Scientists

Many Success Stories Are Yet To Be Written

The need for more cost-efficient production and the demand for agricultural products will continue to grow in the 21st century. The question in many minds: Will American agricultural scientists be able to keep pace, pushing the frontiers of knowledge and technology?

Unfortunately, studies show the pool of human resources we have to draw on is dwindling. Over the last years, fewer American students seem motivated to pursue careers in science and engineering. At the same time, demand for people in these professions is on the upswing.

In ARS, we're concerned enough about the decreasing student interest in science and engineering that we're continually looking for ways to spark the interest of young people. Since we expect more than half of the nation's work force to be composed of women and minorities by the year 2000, we're trying to make sure that an increasing number of such students become scientists and consider careers with the Agricultural Research Service.

Many of today's science and engineering students are not aware of the challenging opportunities available in agriculture. This is particularly true of students from urban areas.

We must work to increase the visibility of ARS and the federal government as a whole as an employer. To support this effort, many of our scientists regularly visit schools and talk with students. Our research centers conduct open houses for the community and tours for student groups. We are pleased to be invited to schools, and we welcome interested citizen groups to contact our local worksites directly about guided tours.

Our Teachers Research Fellowship Program provides temporary employment for junior and senior high school science and math teachers. The objective is to educate teachers about ARS and hope they will carry this increased awareness back into the classroom, at the same time instilling an interest in the students to pursue a career in science.

We're especially proud of the success of our Research Apprenticeship program, which began in 1980. Each year, some 200 high school students work with us for 8 weeks during the summer as biological, physical, or engineering aides. Being a research apprentice means gaining firsthand experience, interacting with our scientists, and getting to know what the field of science has to offer.

One excellent system used throughout the federal government is the Cooperative Education Program. It provides an opportunity for high school through graduate students to work with ARS part-time or for alternating sessions, while still enrolled in school. The students are employed in positions with duties relating to their academic major or career goals.

A similar academic program is the Federal Junior Fellowship Program for high school seniors who are going on to college for a bachelor's degree. The junior fellows work with federal agencies during summers and other vacation and holiday breaks from school.

Then there are other employment opportunities for students that do not require the work to be related to their academic major, such as the Stay-in-School Program and the College Work-Study Program. All of these programs have as their first objective supplementing the student's education—either academically or financially.

We have already had many success stories, some of them really dramatic. But I believe the most spectacular success stories are yet to be written. After all, when we're talking about employment programs as I've just mentioned, we don't expect to see immediate results. We can only hope a student's work experience with us provides a better idea of what agricultural research is all about. If we're lucky, that experience may kindle a desire in at least a few to pursue a career with us.

Of course, we can't convert young people into instant scientists of tomorrow, simply by creating programs for them. These programs are a starting point. Beyond that, it takes sensitivity and care to make sure the tasks they're given dovetail with their strengths and interests. Students at the same grade level in different regions of the country may have very different academic skills and bases of experience. All of us, as personnelist, researcher, community leader, or just as the neighbor next door, must make an effort to spur interest in science and agriculture and educate the public, particularly our young people, whenever the opportunity arises.

Jane Giles
Director of Personnel
Agricultural Research Service

Agricultural Research

Cover: Deborah Wagaman (left), a science teacher at the Chesapeake High School in Baltimore, Maryland, explains plant classification to biology students Tim Johnson and Detra Knight. Working under the Teacher Fellowship Program, Wagaman gained actual laboratory experience last summer in ARS' Climate Stress Laboratory at Beltsville, Maryland. Photo by Perry Rech. (K-3405-11)

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JOHN KUCHARSKI

The ARS National Visitor Center in Beltsville, Maryland. (K-3410-11)

OPENING THE DOOR TO AGRICULTURAL SCIENCE

The real-life teaching experiences offered by the Agricultural Research Service's new National Visitor Center mean a lot to Professor Henry J. Bindel, Jr., of George Mason University near Washington, D.C.

Of four field trips to research facilities that Bindel arranged this year, a day at the National Visitor Center was unanimously rated the best by his science workshop teachers.

"It's because teachers talk about animals and plants of all kinds but don't have much exposure to them. On the ag science tour, they not only see a cow, a pig, or a greenhouse full of unusual plants, they get a vicarious research experience. These are living science lessons full of information to take back to their students."

Because he lives nearby, Bindel enjoys an inside track—he was one of the first professors of education to learn about the new visitor center.

Educators visiting or living near the nation's capital can, for the first time, find an attractive educational stop devoted to the international importance of agricultural sciences.

In 1987-89, the agency renovated a historic Log Lodge into the ARS National Visitor Center. It is located on a lake and nature trail amidst the fields, barns, and research buildings at the 7,200-acre Beltsville Agricultural Research Center, just off the Capital Beltway in Prince George's County, Maryland.

At the Visitor Center, entomologist Jeffery Aldrich shows Scott and Lynn Marie Kucharski a beneficial predator insect—the spined soldier bug. (K-3428-19)

The Beltsville Log Lodge is an easily recognizable visitor point. It was originally built from blueprints of lodges in Yellowstone National Park by the Depression-era Civilian Conservation Corps. They used trees from forests on the research center.

While the lodge's architecture is a classic reminder of our historic legacy, colorful displays erected inside in 1989 offer visitors a look into the future—where current research will likely lead our food and farm industries. Visitors learn about plant breeding and biotechnology, animal nutrition and disease prevention, soil conservation, irrigation technology, biological control of pests, and human nutrition studies.

Other exhibits tell of careers in agricultural science and engineering, the products and inventions of the research, ARS interaction with regulatory agencies, and the ARS Science Hall of Fame.

The staff of the National Visitor Center offers tours of the Beltsville Research Center to visiting scientists, business people, foreign visitors, and the general public. Telephone (301) 344-2483 for reservations.

However, the lodge's most frequent visitors are teachers and students. In the first half of 1989, classes from 71 different schools and colleges came to the visitor center. Tours are tailored to students at levels from elementary to graduate school.

Many educators have called or stopped in for assistance—materials and ideas on ARS experiments and accomplishments. The visitor center staff also puts teachers in touch with science mentors from agency laboratories who can help students. The staff maintains a list of ARS speakers for schools, and provides judges for science fairs, career days, and events of the 4-H and Future Farmers of America.

Diana McCusker, a teacher at Oxon Hill High School, a science magnet school in southern Maryland, organized a summer 1989 visit for about 50 science teachers. "Beforehand, they had no idea that so much was done in agricultural science. They especially liked seeing actual laboratory work captured on video. The displays, tours, and video were all very illustrative."

James Strandquist, kindergarten through 12th grade science supervisor for Prince George's Public Schools, talks about a new front door to USDA science. "From an organizational standpoint, it provides people with a place on which to focus when we talk about USDA."

Strandquist points to changes in many schools' approach to science. "We are adjusting our programs to emphasize scientific method—a lifelong strategy in problem solving. The visitor center will help broaden our students' understanding of proper method, not just the stuff of science."

Another educator in close contact with the visitor center is Vera Zdravkovich. She is a former research chemical engineer who now heads the Science Resources Center at the Prince George's Community College. Zdravkovich cooperates with about 20 different public and private research facilities on science workshops and conferences for high school and college students.

"It is important for today's scientists to realize that they have an obligation to share their world with young people," she says. "And students need to realize that science is not cold, but full of human interest. They need to be exposed at an early age to the science experience. It is wonderful that there is now a focal point for talking with USDA scientists who want to talk and work with our students."—By **Stephen Berberich,** ARS. ◆

JOHN KUCHARSKI

At ARS' Beltsville Agriculture Research Center, Gonzaga High School students collect soybean leaves for DNA extraction under supervision of microbiologist John O'Neill (background standing, left) and Father Lelii (center). (K-2423-1)

THESE STUDENTS TRACK DISAPPEARING SOYBEAN GENE

For the past 15 years, plant geneticist Thomas E. Devine has been looking at the genetic structures and characteristics of soybean plants. And for the past 15 years, a succession of talented high school and college students have been looking with him.

"We're not talking about mere academic exercises," Devine says. "These students are doing work of real scientific significance. They're making original contributions to our knowledge about soybean genetics."

They're also making it possible for Devine and microbiologist John J. O'Neill at the ARS plant molecular biology laboratory in Beltsville, Maryland, to conduct long and detailed studies of thousands of soybean plants in an effort to track down the genes responsible for critical functions such as disease resistance and nitrogen fixation (the ability of a plant to take and use nitrogen from the air).

Geneticist Tom Devine watches as Gonzaga High School student Peter Sweeney inoculates soybean seeds. (K-3425-9)

BOB BJORK

"Without these students," says Devine, "much of our research in soybean genetics would come to a stop. We simply do not have the time or staff to perform all the necessary tests and investigations."

Devine usually works with several students a year. Over the years, many of them have come from Gonzaga College High School, a nearby parochial school in Washington, D.C.

"Father Raymond Lelii, a biology teacher at Gonzaga, lets his students know about our labs at Beltsville, the work we do, and the opportunity for them to do a science fair project by working with us," Devine says. "He brings around 12 students here each October. We interview them and place them with various scientists—including myself—to work on selected aspects of ongoing research."

Some of Lelii's students have won top honors at national as well as local science fair competitions with projects done under the guidance of Devine and other scientists at the plant molecular biology lab.

"Keep in mind that they did the work and that their projects were important to the agency," says Devine. "We provided a lot of guidance, of course. But they performed the experiments, collected the data, and wrote the reports. And their findings have been incorporated into our own published papers."

In recent years, students from Gonzaga have been helping Devine track down what could be an important soybean gene that appears to be disappearing from many soybean varieties. Devine and his students found that the gene known as *Rj4* prevents the formation of root nodules by certain unwanted strains of bradyrhizobia—the soil bacteria that forms root nodules on soybeans grown in the United States.

Although root nodules in legumes like soybeans are essential for nitrogen fixation, explains Devine, they can present a problem when the wrong kind of bradyrhizobia causes the nodulation.

"There are strains in the soil that do a poor job of fixing nitrogen when they nodulate with the roots of soybean plants," Devine says. "This inefficiency in nitrogen fixation could very well cause a decrease in soybean yield and protein content."

BOB BJORK

University of Maryland student Omogwefe Gbemiya-Etta collects pollen from soybean plants. (K-3226-6)

Soybean varieties containing the *Rj4* gene would alleviate this problem, according to Devine, by avoiding many of the undesirable bradyrhizobial strains and permitting nodulation with more efficient strains in the soil.

"There are always many *Rj4*-compatible strains of bradyrhizobia present in the soil," Devine says, "so there won't be any decrease in nodulation because of the *Rj4* gene."

"Without these students," says Devine, "much of our research in soybean genetics would come to a stop."

To determine which strains of bradyrhizobia are in fact restricted from nodulation by the *Rj4* gene, students working with Devine grew isogenic (nearly genetically identical) soybean lines with and without the gene in a special medium inoculated with pure cultures of bradyrhizobia.

"A whole series of bradyrhizobial strains were rejected by the *Rj4* gene," says Devine. "Most of these rejected strains, we found, interfered with chlorophyll synthesis. Furthermore, we found that they were more closely related to each other in DNA structure than to *Rj4*-compatible strains of bradyrhizobia. Indeed, we have determined that the rejected strains belong to a distinct DNA grouping."

These findings have already changed scientific thinking about the *Rj4* gene. Instead of being viewed as a random mutation or aberration in soybean genetics, the gene is now recognized as a positive asset to be reincorporated into those soybean lines that lost it along the way.

"We don't know why its frequency in soybean plants decreased," says Devine, "but possibly it was linked to other genes that were detrimental in modern agriculture and were therefore bred out of soybeans like genes that promoted seed pod shattering, for example."

The question is more than one of academic interest, says Devine, and students in his lab are now studying how the gene is linked to others on soybean chromosomes.

"Once we identify those traits linked to the *Rj4* gene," says Devine, "I'm confident that modern biotechnology can incorporate the *Rj*4 gene into soybean cultivars of the future. And when that happens, the overall yield and protein content of our soybean crop in many areas are likely to increase as well."—By **Steve Miller,** ARS. ◆

AN ARS LAB REAPS WHAT IT HAS SOWN

A scientist? Well, that's a little old man with gray hair in a white lab coat shaking up test tubes.

This would have been Nikola Lockett's exclusive definition of a scientist at age 10. And becoming one was as far away as the moon.

Now that she's a senior at Xavier University in New Orleans and employed at an ARS lab there, she sees scientists as real people performing exciting jobs. And becoming one is a realistic goal.

Throughout her early years, Lockett's ambition was to be a secretary like her mother. It was an idea that quickly changed once ARS hired the high school junior under a Stay-in-School program.

During her first two summers at the Southern Regional Research Center, Lockett did so well that scientists wanted her back. When she entered college, they hired her under a program that allowed her to work full-time during the summer and up to 20 hours each week during the school year.

"Nikola is a conscientious employee and an important part of the Cotton Fiber Bioscience team," comments supervisor Barbara Triplett. "Over the past 5 years, I've watched her grow from an eager beginner to an valued contributor."

Triplett, a plant physiologist with the Microbial/Plant Technology Research unit, fully supports hiring students to work in the lab. She herself once worked as a student researcher at Reed College. Now, in working with the trainees, she feels she returns her appreciation for the opportunity in some measure.

Triplett says Lockett has been involved in about every activity associated with the group's research project on improving cotton fiber quality.

"This job helps me finance my education, and it also helps me at school," Lockett explains. "The first time one of my assignments called for mixing chemicals with different ratios of weight to volume, I came through with flying colors because of my experience at the lab."

Triplett says that Lockett's college work has contributed to her success on the job. "As she developed a background in science, I could see that projects Nikola before thought merely interesting now made sense. This helped her to work more independently and to handle more responsibility."

In two of her recent scientific publications evaluating fiber from cotton fiber mutants, Triplett cites Nikola Lockett for her technical assistance.

Since she's a pharmacy major, Lockett doesn't plan a career with ARS after graduation. However, graduate school is next on her carefully planned agenda. She cites working at the Southern Regional Research Center (SRRC) and role model Barbara Triplett as factors that have helped her realize that "research is where I want to be."

Two other students are delighted with their jobs at SRRC—Detra Madison and Kathryn Guice.

They are two of nine Southern University students majoring in fields related to food and textiles that were hired by the center for the summer.

"SRRC is an ideal workplace for students interested in these fields," says center director John A. Barkate. "Our textile mill provides practical experience with fibers from the bale to finished product."

And although Kathryn Guice is primarily interested in the merchandising end of fashion, her first summer in the Fiber-to-Fabric Processing Research unit has been "enlightening."

JACK DYKINGA

In studies to improve cotton fiber quality, Stay-in School student Nikola Lockett measures the growth of cotton plants. (K-3398-7)

ARS Programs for Student and Temporary Employment

- Applicants must be at least 16 years of age, be a citizen or permanent resident and may not be hired for a position under the supervision of a relative.
- All salaried full-time and part-time employees earn sick leave.
- Salaries are above minimum wage unless otherwise stated and depend on the level of skill required.
- Minorities and females are encouraged to participate in all programs.

Career Related Programs	Student status	Work schedule	Insurance health/life	Apply to	Lead time for appl.
Co-op Education - provides flexibility in integrating academic studies with career-related work experience for **students** in high school, trade, technical, business or vocational schools, and associate, baccalaureate, or graduate programs.	variable	individual-ized	eligible	educational institution	1 month
Federal Jr. Fellow - provides summer and vacation employment for outstanding **high-school seniors** headed for college. Must be in top 10 percent of class and nominated by school official.	full time	summer and vacations	eligible	high school	1 month
Research Apprenticeship - provides **high-school students** with eight weeks of experience working with scientists in food and agricultural research.	full time	summer	ineligible	high school or ARS (address below) *	varies
1040 - provides **high-school and college students** with practical experience assisting scientific, professional, or technical employees not to exceed 1,040 hours per year.	full time	part time, full time or intermittent	ineligible	ARS*	1 month
Volunteer - provides **anyone** the opportunity to gain work experience related to their educational objectives. No salary.	none	part time, full time, or intermittent	ineligible	ARS*	1 month

Programs Based on Income

College Work-Study - provides part-time earnings for **college students** to pursue their education at institutions participating in this program.	half time	part time (set by college)	ineligible	educational institution	1 month
Stay-In-School - provides needed earnings for **high school and undergraduate college students** to continue their education.	full time	part time/ full time summers	ineligible	educational institution	1 month
Summer Aid - provides jobs for needy **young people**. Minimum wage.	none	summer	ineligible	state employment service	3 months

Other Programs

L/A Appointment - enables ARS locations to hire **anyone** as field/laboratory workers as needed for no longer than 6 months per year. Applicants should be at least 18.	none	part time, full time, or intermittent	ineligible	ARS*	varies
Summer Employment - provides employment for **anyone** from May 13 through September 30.	none	summer	ineligible	ARS*	3 months

*Write to USDA-ARS, Personnel Division, Personnel Operations Branch, 6305 Ivy Lane, Greenbelt, MD 20770-1435

"I couldn't believe there were so many things to learn about cotton fiber," she says.

Kathryn runs cotton fibers through a carding machine to separate the fibers, placing them on a board under a microscope to seek imperfections in the sample. Then she classifies the imperfections as biological, machine-generated, or seed coat fragments. Kathryn also checks for defects in knitted and dyed fabrics.

Detra Madison, Southern University sophomore, is more interested in food than fabric. Hired by SRRC's Food Flavor Quality Research unit, Detra prepares trays for panelists tasting peanuts, beef, and catfish.

The trays hold butter, wheat thins, sucrose, applesauce, and orange juice—products that help prepare a panelist to identify tastes as salty, sweet, sour, or bitter.

"Working with the scientists here has reinforced my decision to make my career in some aspect of food nutrition," Detra says. "I'd like to work here permanently after I finish school." And that's a goal that Stanley Perkins and Glenn Johnson have attained.

Stanley, now a full-time physical science technician in the Food Systems Research unit, was brought on board under a Cooperative Education Agreement with Xavier University in his junior year.

For each 6 months at the lab, Stanley earned 3 credit hours at the university, accruing a total of 9 hours.

"My first 6 months here were a good introduction to the real research world," Stanley says. "I started off as a pharmacy major and switched to chemistry. After being in the lab for a while, I realized this switch was the right one. I'd like to get a Ph.D. in analytical chemistry to further my career in the agency."

JACK DYKINGA

▲ **Physical science technician Glenn Johnson looks up from his computer data analysis. (K-3402-1)**

▼ **Now a career employee, part of Stanley Perkins' college days were spent at ARS under a cooperative education agreement with Xavier University. (K-3401-10)**

JACK DYKINGA

Like Stanley, Glenn Johnson works as a full-time physical science technician in the Food Systems Research unit. "I started here as a senior in high school, working half a day and going to class the other half," he comments. "I was well prepared for college since the work here exposed me to lab techniques and equipment that most other students had never heard of."

Not many college freshmen can boast of experience in spectroscopy.

When Glenn entered the University of New Orleans as a biology major, ARS hired him again, scheduling work hours around his classes.

Stanley and Glenn are now working on a project that tests the gelatinization of rice starch. Using a differential scanning calorimeter, they test different varieties of rice to see how the starch in each variety gels.

Teachers as well as students profit from work experience at SRRC.

Ron Traylor, chemistry and physics teacher at a high school in Covington, Louisiana, has been teaching science for 19 years. Ron has now spent two summers working with the meat program in the Food Flavor Quality Research unit under the direction of research physiologist Arthur M. Spanier.

"So many things changed during the years I was out of research," Traylor says. "Here I'm exposed to new research techniques, new instrumentation, and research by computer analyses."

He uses analytical methods, including gas chromatography, electrophoresis, and spectroscopy, to examine the flavor components of food. This will enable him, he says, to give concrete examples when asked by his students: Why do I need to know this? "My interaction with the scientists here at the center is an invaluable experience for a science teacher," he continues.

Traylor made a videotape of scientists at work in the lab this past summer. "Showing this will be much more effective for the kids than telling them to turn to page 480," he says.

Director Barkate is pleased with the students and teachers who have worked at SRRC. "We like to think we are shaping tomorrow's agricultural scientists," he says.—By **Doris Sanchez,** ARS. ◆

ALL SUMMER, TEACHER'S A RESEARCHER

(K-3422-10) JOHN EBBLING

Evans Junior High teacher, Traci Higgins, Lubbock, Texas.

Jim Lloyd watched the whole sweltering summer go by as he sat shivering in a long-sleeved jacket.

The irony is that as much as Lloyd despises being cold, he says he'd gladly do it all again. As summer jobs go, this year's was something special—and that's the message he planned to take back to his chemistry and biology students at Atoka High School, Oklahoma.

Lloyd, a teacher since 1966, was one of 42 participants this summer in ARS' Teachers' Research Fellowship Program. The program, conceived in 1986, hires high school and junior high school science and math teachers for summer jobs as lab technicians in the hope that the teachers will convey some of the excitement of real-life research to their students come fall.

According to Jim Lloyd, the idea works just fine. "When I talk to students about science projects now, I have a feel for laboratory equipment that I didn't have before," he says. "I hope to be able to take them out to the lab and show them the things I worked on. That could be an important learning experience for them, because they'll ask me questions that they wouldn't ask a stranger."

Lloyd worked under the direction of plant physiologist Penelope Perkins-Veazie at the ARS South Central Agricultural Research Laboratory at Lane, Oklahoma.

"I was involved with experiments on different types of packaging for eastern Oklahoma grapes after harvesting and evaluation of the shelf-life potential of these grapes," he recalls. "I took samples of the air around them in cold storage to see what gases were being given off—in other words, how the grapes were handling storage."

> "My glasses fogged up all the time..."

And just how cold was the cold storage?

"Much of the gas sampling was done in a room that was about 35°F, with fans blowing," Lloyd says. "My glasses fogged up, and a lot of the time I was in the lab with a jacket on. This was the first time I felt like I'd completely missed summer."

To say that Lloyd's experiences were typical wouldn't be quite true, since each slot in the Teachers' Research Fellowship Program is custom-designed to fill a specific research need.

For example, Traci Higgins, an eighth-grade earth science teacher at Evans Junior High School at Lubbock, Texas, spent her summer at the Plant Stress and Water Conservation Research Laboratory at Lubbock. Under the direction of plant physiologist John J. Burke, she learned how to measure the cellular responses of plants to heat stress.

But Steve Pierce, another eighth-grade earth science teacher from Mary Hoge Junior High School at Weslaco, Texas, had very different "hands-on" experiences—such as having his arms swell to the elbows as he helped entomologist Evan A. Sugden survey south Texas' wild honey bee population.

"I had a few stings," Pierce says of his early days at the Honey Bee Research Laboratory. "But the swelling was just until I became acclimated. I think it was par for the course."

All three teachers said they would carry back to the classroom—and their students—a clearer picture of the challenges and rewards of working in a research laboratory.

That vow represents a dream come true for John R. DeLoach. He is the research leader at ARS' Veterinary Toxicology and Entomology Research Laboratory at College Station, Texas, and the originator of the idea for the Teachers' Research Fellowship Program.

"I'd been kicking around this idea in my head for a couple of years," DeLoach says. "We're facing a real shortage of scientists and engineers in

(K-3415-7) DAVID NANCE

Jim Lloyd, Atoka High, Atoka, Oklahoma

(K-3416-1) DAVID NANCE

Science teacher Steve Pierce, Weslaco, Texas

the 21st century, and I hoped a program like this would help."

Early in 1986, DeLoach took his idea to Jane Giles, then area administrative officer for the Southern Plains Area headquartered at College Station. *[Editor's note: See* Forum, *page 2]*

"I told her that I had an idea for trying to increase interest among high school students in science careers," he recalls. "I thought one way to reach the students was through their teachers."

DeLoach envisioned a program in which "we'd employ junior-high or high-school teachers to come work in the labs, not washing dishes or tending sheep, but in a bona fide program where they could experience first hand what it's like to do research—the frustration and the excitement of working in a laboratory ."

With the support of J.R. Johnston, then area director for ARS' Southern Plains Area, two positions were offered in the summer of 1986 at College Station, each funded at $4,000. The first two participants came from Caldwell Junior High School at Caldwell, Texas, and Bryan High School at Bryan, Texas.

As DeLoach had hoped, the participants were not just "washing dishes or tending sheep." One carried out experiments on encapsulating drugs in red blood cells, work that has become the basis for clinical trials under way now on use of a drug to treat animals for lymphoma.

The other worked on experiments to determine how T-2 toxin, a naturally occurring poison produced by fungi on grain, interferes with the immune system of animals that eat the grain.

Through a special arrangement with the College of Education at Texas A&M University in College Station, participation in the program in Texas also can offer up to 6 hours' graduate credit. The teacher who worked on T-2 toxin contributed to two scientific papers on that research.

DeLoach subsequently made a presentation on the program to a gathering of ARS' area directors. The idea was so favorably received that by the end of the summer of 1989, 74 teachers had participated in the program in 7 of the agency's 8 areas nationwide.

"Each area director has flexibility on the number of positions he'll fund," explains Jane Giles, now director of the Personnel Division at ARS headquarters at Beltsville, Maryland. "But there has to be a reason for the position; we're not establishing jobs just to get teachers into the laboratory environment.

"Most of the areas have a process where the scientist is asked to submit a proposal. Then the area director looks at the proposal to see if it's a meaningful assignment, and he decides which ones to fund." The teacher-applicants are recruited through local school districts.

Floyd P. Horn, now area director for the Southern Plains Area, says the program is targeted at junior- and senior-high teachers because "those grade levels are the age groups when students begin to think about career pathways. We want to encourage them to think about science.

"Teachers have a big effect on their students," Horn continues. "Everyone remembers one or two teachers in high school who really influenced their lives. If we get the right teachers in this program, we can reach many students. And I think whenever any teacher can speak from experience to students, it has to strengthen that teacher's arguments."

DeLoach is also optimistic that the program will help attract youngsters to science careers.

"But this is a long-term endeavor," he emphasizes. "If you're touching the mind of a seventh-grader today, it will be years before you see the results in a scientist.

"One teacher said she didn't expect her students to understand what goes on in a research lab. But the concept of creativity, so nurtured in the lab, is something she said she would try to instill in the minds of her students—to be creative, to ask 'why.'"—By **Sandy Miller Hays**, ARS.◆

SORTING BUGS? YOU'RE KIDDING

The High School Research Apprenticeship Program in Laramie, Wyoming, has been so successful and the scientists so enthusiastic that when his laboratory failed to get the $5,600 needed to hire four students last summer, Thomas E. Walton found a way to come up with the funds himself.

"I couldn't be happier with the apprenticeship program," says Walton, research leader at the ARS Arthropod-Borne Animal Diseases Research Laboratory. "Two former apprentices, now attending the University of Wyoming in Laramie, are working part-time at the laboratory."

One of this year's four research apprentices, Tamara Banwort, shares Walton's enthusiasm.

"Most people never get this kind of opportunity," she says. "In 8 weeks, I learned what it's like to work with scientists in a laboratory." Tamara is majoring in mathematics at Iowa State University and hopes to teach junior high school.

Another research apprentice, Angela Turner, helped raise colonies of the biting midges *(Culicoides variipennis),* or gnats, that spread bluetongue virus, which causes bluetongue disease in sheep and cattle.

She also preserved and measured adult insect wings so the scientists could check the vigor of flies bred in rearing facilities. "I was worn out after my first week in the lab, but I really enjoyed working with the scientists and technicians," she says.

Angela is attending the University of Wyoming this fall. From there, she hopes to go on to medical school.

Entomologist Frederick R. Holbrook, who supervises the students, says bluetongue is one of the world's most serious livestock diseases. The virus, carried by the tiny, biting midges, can kill more than 40 percent of an affected flock of sheep and reduce cattle reproduction.

According to Holbrook, bluetongue disease is the most serious barrier to exporting U.S. cattle, sheep, and their semen and embryos to countries where bluetongue is not currently found, such as in eastern Europe and parts of Asia.

"We want to be able to predict where and when outbreaks of bluetongue may occur," he says. To do this, the scientists are studying the environmental conditions—temperature, humidity, livestock density, and food supply—under which the midges thrive and spread bluetongue virus. This information may provide clues about how to interfere with the way the insects breed and spread disease.

Apprentices Emily Parker and Angie Wiegand also assisted with the project. "Each of the apprentices is an "A" student," says Roger Abelson, science teacher at Laramie High School. He helps the scientists recruit them.

Emily Parker spent part of last summer cutting tiny windows into chicken eggs and inoculating the live embryos to detect the virus. "That was probably the closest thing to brain surgery I'll ever do," says Emily.

Emily also helped create and manage an artificial breeding site for studying the growth and development of the immature stages of the insect.

Emily was valedictorian at her high school graduation and hopes to study at Stanford University.

Angie Weigand expects to major in engineering or computer science. As a research apprentice, she sorted insect collections and helped out in other ways around the lab.

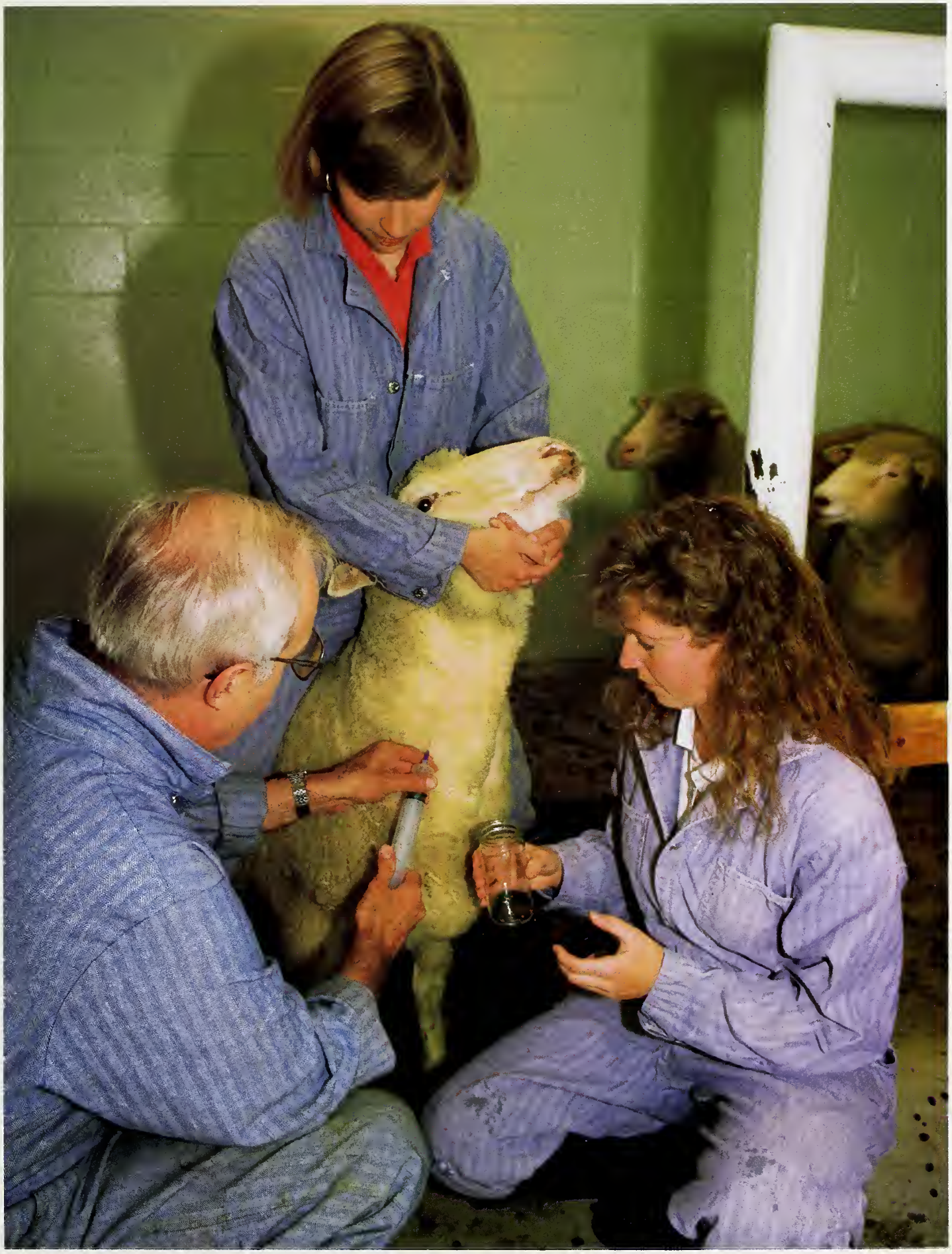
"I used to think it would be glamorous to be a scientist, but a lot of the work is hard and repetitious," she says. "I'll remember what *Culicoides variipennis* looks like till the day I die. When I tell friends I've been sorting bugs, they stare at me as if to say, 'You're kidding!'"

"The most important thing I learned this summer? Make sure you get it right. If you don't, try again."—By **Howard Sherman,** ARS. ◆

LOWELL GEORGIA

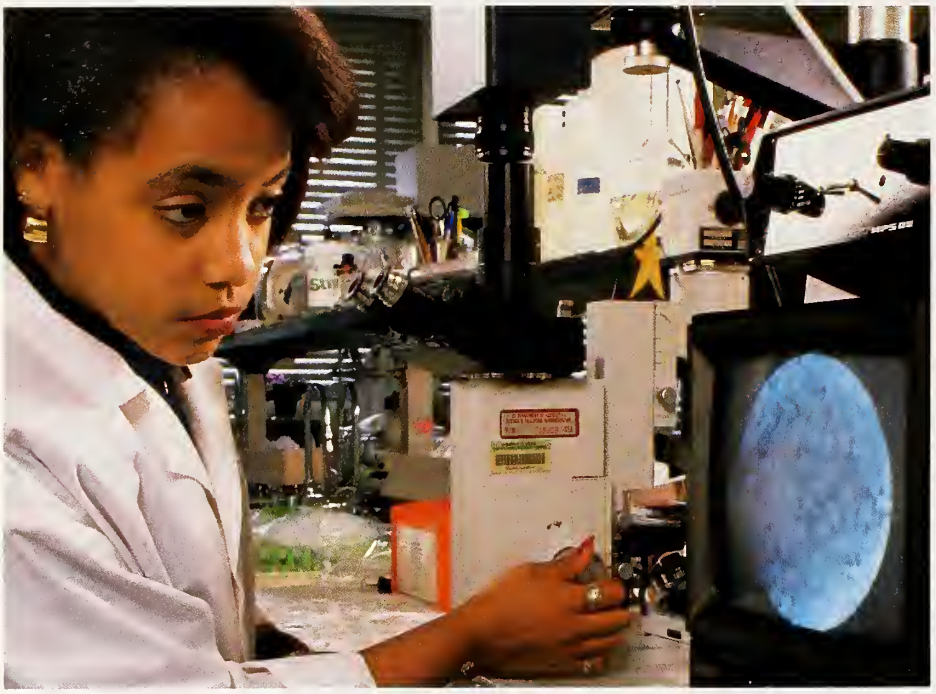
To help monitor flying insects such as the biting midge that carries bluetongue virus, Angela Turner (left), Angie Weigand, Tamara Banwart, Fred Holbrook, and Emily Parker gather samples from a light trap. (K-3418-10)

▶ Biological technician Howard Rhodes takes a blood sample while High School Research Apprentices Emily Parker (standing) and Angela Turner assist. (K-3417-9)



LOWELL GEORGIA

GROWING OUR OWN SCIENTISTS



ROB FLYNN

Sonya Jordan, a student intern, analyses the ability of milk formulations and milk substitutes to promote the growth of kidney cells in culture. (K-3396-6)

Clark Central High School senior Sonya Jordan could have been flipping burgers in a fast food restaurant last summer. But she wasn't.

Instead, Jordan spent 8 weeks learning advanced cell culture techniques and then running her own research project under the direction of an ARS scientist.

She was one of the first students in a new project planned to ensure that there will be a next crop of scientists to continue the work of the Agricultural Research Service. The program's aim is to plant the seeds of future researchers early and hope for harvest years down the road.

At least that's what David E. Zimmer, director of ARS' Richard B. Russell Agricultural Research Center in Athens, Georgia, had in mind when he assembled an assortment of ARS student programs to create a grow-your-own-scientist plan.

His idea was to start by recruiting students between their junior and senior year of high school and provide them with summer jobs that would involve them in real research projects, not just boring work like washing glassware or filing papers.

If the students elect to go on to college in an appropriate science major, Zimmer will provide a continuing summer position in one of the Russell Center's labs.

And if they are interested in graduate school in an agriculture-related specialty, they may compete for a more advanced lab job and an opportunity to attend the University of Georgia graduate school, which cooperates with the Russell Center.

"We want to take students who have an interest in science to begin with and make it easy for them to stay with ARS from high school to college to graduate study to hopefully a research position with us someday," Zimmer says.

Zimmer has made a special point of attracting minority students to the program. "Many minority students just aren't familiar with what ARS does and the number and diversity of science positions ARS has to offer," Zimmer says. "If we don't let them know about the opportunities from the start, they may never consider going into an agriculture-related field, even though they have a genuine interest in science."

He makes regular recruiting trips to nearby high schools to ensure that science teachers and counselors know about Agricultural Research Service's desire to grow its own scientists.

It was Jordan's chemistry teacher who told her about the program. She was selected as one of the three students to participate in the program, which began last summer.

After a placement interview with Zimmer, Jordan was assigned to Ronald T. Riley, a research pharmacologist in the Toxicology and Mycotoxins unit of the Russell Center.

Riley's primary research interest centers on the interaction of fungal toxins on cell membranes.

Understanding how fungal toxins alter membrane function will help us to assess the health risks posed by consumption of contaminated foods and feeds.

But Riley didn't want Jordan to spend her summer as a lab drone doing repetitive tasks on his experiments.

"I wanted this to be an educational experience for her, learning skills and applying them, rather than just being a lab lackey," he explains. "The only way to learn about research is by doing all of it—encompassing all aspects of research from methods development to gathering data to putting it on the computer and analyzing it. Of course, that also in-

ROB FLYNN

◀ **Microbiology student Susan Brooks assists chemist Ray Severson in analyzing petunia plants for possible tobacco budworm egg-laying stimulants. (K-3395-1)**

▶ **Student intern Charia Mitchell uses a collection system to determine the fiber content of various forages. (K-3396-11)**

ROB FLYNN

cludes washing the glassware and maintaining cultures."

Jordan spent her first 4 weeks learning the techniques of cell culture. Then Riley pointed out that cells raised *in* vitro require the addition of growth factors to the media so they'll thrive. Usually, commercial serum is added to provide the growth factors, but Riley had read a technical paper that indicated nonfat dry milk has also done the job.

So for the rest of her tenure, Jordan conducted a research project comparing the efficacy of nonfat dry milk, skim milk, Similac (an infant formula), ProSobee (a soybean-based milk substitute), and human milk as a source for growth factors.

"It was a meaningful summer, not like working at a burger shop," says Jordan, who is thinking about a career as a pharmacist.

Susan Brooks, a sophomore microbiology major at Southern University in Baton Rouge, Louisiana, was also recruited for Zimmer's program. She graduated from Cedar Shoals High School in Athens and had already worked a few summers in ARS labs.

Last summer, she worked with research chemist Ray F. Severson in the Tobacco Quality and Safety Laboratory at the Russell Research Center studying insect-host plant interactions.

Severson is looking for chemicals that naturally occur in plants that modify insect behavior—either by attracting or repelling them or even by poisoning them.

"For example, commercial tobacco varieties have compounds on their leaf surface that are ovipositional stimulators for budworms—attracting females to lay their eggs on the leaf," Severson says. "We have identified and isolated the stimulatory compounds and produced tobacco plants that do not have them. These plants can be grown without pesticides and still suffer no damage from budworms."

Severson also looks for wild plants that have natural repellents to insect pests. "Once we isolate the specific compound that repels a pest, we can breed for plants that have more of it or even introduce the production of it into unrelated crop species by genetic engineering," he says.

Brooks started off her summer performing routine lab work. But she displayed the ability to master more complex duties, quickly learning how to perform sophisticated techniques in chemical extraction, fractionation, and analysis.

She also went on a number of trips to locations in Georgia, South Carolina, North Carolina, and Tennessee, helping to collect plant samples.

"Her interest in microbiology as a potential career broadened the types of things we were able to teach her to do," Severson says.

Brooks especially liked working with the gas chromatograph and the computers in the laboratory. "I've learned a lot this summer and the money I've earned really helps out too," Brooks says.

Charia Mitchell, a senior at Cedar Shoals High School, spent her summer working with ARS research associate Janet Woodward in the Plant Structure and Composition Research Laboratory at the Russell Center. Woodward is seeking to develop enzyme analysis techniques for forages.

"We are trying to apply enzyme tests used in human nutrition to warm and cool season grasses and legumes in order to classify fiber on a physiological and biochemical basis," Woodward explains.

Mitchell worked at all the different tasks that a regular technician would perform in Woodward's lab, from drying and grinding plant samples to photographic techniques involved in electron microscopy. She learned to operate complex lab equipment including computers and gas chromatographs. "She did a little bit of everything," Woodward says.

While Mitchell is leaning towards a future in engineering, the summer gave a new insight into science. Woodward sums it up. "We'd be glad to have her back next summer."—By **J. Kim Kaplan,** ARS. ◆

MEMORABLE TEACHING, MEMORABLE SCIENCE

It was nearly 20 years ago, but Elizabeth Sullivan's memory of him remains colorful and sharp. "He was a tall man with great enthusiasm, and he was really the only teacher I knew who cared about science," Sullivan recalls.

"He inspired me; he let us try lots of things that were our ideas instead of his." She smiles for a moment, then adds: "It all must have stuck. Everything Terry Knapp taught me seems to come into play now when I'm teaching."

For the last 3 years, Sullivan has taught science at the Father Sweeney School in downtown Peoria, Illinois. It is a school for gifted students, many of whom say they've already decided on becoming doctors or lawyers.

Her students, in fourth through eighth grade, have an interest in science, but one that has not been formally nurtured or encouraged. They come to the Sweeney program from other schools, eager to learn something novel, something wonderful.

"What I try to do for these kids is excite them about science," she says. "I've met teachers who tell me they don't have time to teach science. At best, their kids get science maybe 15 minutes a day. And it's usually right out of the book. So I feel that I'm in a unique position because I teach only science. I can concentrate on just that and make it interesting."

As part of ARS' Teacher Fellowship Program, Sullivan spent last summer doing lab research on biodegradable plastics at the Northern Regional Research Center in Peoria. The lab work, under the direction of research leader J. Michael Gould, sought microbes that would break down various plastic formulations, some of which contained up to 40 percent starch.

To uncover the world of microbial degradation, she and researchers Mary P. Kinney and Christine A. Kowalczyk headed for the organism-rich waters of the Illinois River. There they sank weighted baskets containing 2-inch plastic samples. Twenty-four hours later, they retrieved the baskets and examined the samples. Only slight microbial activity was evident on some of the plastics. They waited a week, then checked again. Little had changed. Finally, after 14 days, they found what they were hoping for: One of the plastic samples had numerous small holes in it, a sign that organisms on the sample were eating away at the starch.

"That's the thing about research—it is not that you can discover something tomorrow," she says. "It takes longer, and that's something the students don't quite understand yet. My students want their experiments to be successful all the time and every time. But success and failure are both part of the scientific experimental process that all researchers face."

Much of Sullivan's lab work has dealt with complex processes of microbe degradation and uses specialized equipment, such as an electron microscope, to detect bacterial activity on strips of starch and plastic. The work is too advanced to take into the classroom. But as a teacher, Sullivan sees her experience in clearly pragmatic terms.

"Bacteria, for example, can be good or bad. That's pretty basic," she says. "Most of my students, though, think all bacteria are bad. I can teach them what good bacteria can do, and we can try to learn more about bacteria by growing them in the classroom."

Last year, her students learned about recycling garbage and the dangers landfills can pose to the environment. This year, she hopes to do more outdoor study at ground level, exploring the role of microbes in breaking down organic matter.

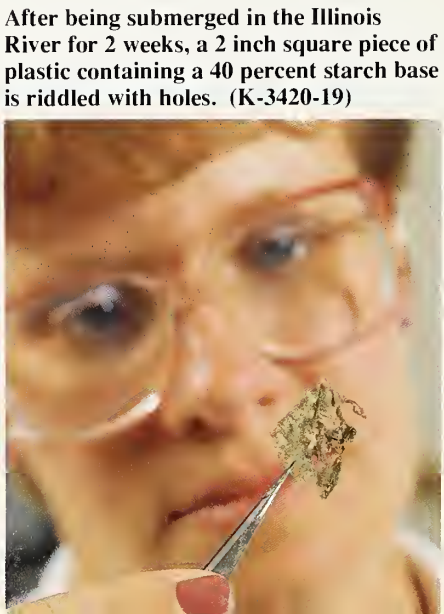
"Working at the lab was an educational opportunity for me, not only because I personally will benefit in the long run but because, through me, it will enhance my students' research awareness," Sullivan says.

"The kids today are the scientists of tomorrow. I hope I can do my part in getting them there."—By **Matt Bosisio,** ARS. ◆

KEITH WELLER

At the Illinois River, science teacher Elizabeth Sullivan inspects made-with-starch plastics (in baskets) for signs that microbes are degrading them. (K-3420-3)

After being submerged in the Illinois River for 2 weeks, a 2 inch square piece of plastic containing a 40 percent starch base is riddled with holes. (K-3420-19)



KEITH WELLER

AN EXTRA PUSH FROM EXTRACURRICULARS

When Kelly Cornish was in eighth grade, she heard two school friends talking about something that made a real difference in her life. That summer her parents enrolled her in an enrichment program, which was part of Tomorrow's Scientists, Technicians, and Managers (TSTM), a program that helps introduce students to science facilities, including the Agricultural Research Service. Kelly joined a TSTM club at one of the Catholic high schools in Peoria, Illinois, and remained an active member for 4 years.

Since 1988, Kelly has earned her bachelor's degree in broadcast journalism from Bradley University, working part time for WMBD radio and for the Catholic Social Service. In addition, Kelly is earning her master's in mass communications at Illinois State University.

"From being in the TSTM club, I learned a lot about hard work and pushing toward a goal. I was made aware of how important it is to get good grades. I especially enjoyed our field trips, like the one to Argonne National Laboratory, and interacting with other students," says Cornish.

Another former TSTM member, Amy Purham, a 1988 graduate of a Peoria public high school, is now a sophomore at Illinois State University, majoring in biology. Purham recently completed her second summer working at ARS' Northern Regional Research Center (NRRC).

"We've been providing summer employment for the past 12 years," says Grant St. Julian, a microbiologist at the Peoria center.

St. Julian was an originator of the TSTM program in the mid-70's. Peoria's club continues to feed qualified students into NRRC's summer youth employment program.

"On average, 90 percent of these young people finish college, graduating in science, engineering, or business. While employed by NRRC, these students fill positions as biological or chemical aides," says St. Julian.

In the late 70's, St. Julian and Maerean Bohannon, formerly with ARS, were inspired by the National Organization of Black Chemists and Chemical Engineers charter to increase minority students' interest in science, engineering, mathematics, and other technical areas traditionally underrepresented by minorities.

Bohannon promoted the idea of TSTM to the Caterpillar Tractor Co. The firm was persuaded to join the Peoria research center in offering employment opportunities.

> "We've been providing summer employment for the past 12 years."

St. Julian developed the guidelines for the club's operation. Club members learn about the kind of work scientists and technologists do, seek employment opportunities through summer youth programs, and determine academic requirements for their chosen fields.

In 1978, Peoria's Tri-County Urban League took over full administrative responsibility for TSTM. Today, seven local businesses support the program with employment opportunities and funding. Basic financial support is provided by the Peoria area Heart of Illinois United Way.

Peoria's TSTM has been recognized by the national organization for an outstanding contribution to minority education. It has become a model for other youth groups throughout the country.

"Our role is to challenge minority youth to achieve more academically. There is a need for highly qualified minorities and females to fill future jobs in science, technology and business," said Campbell.

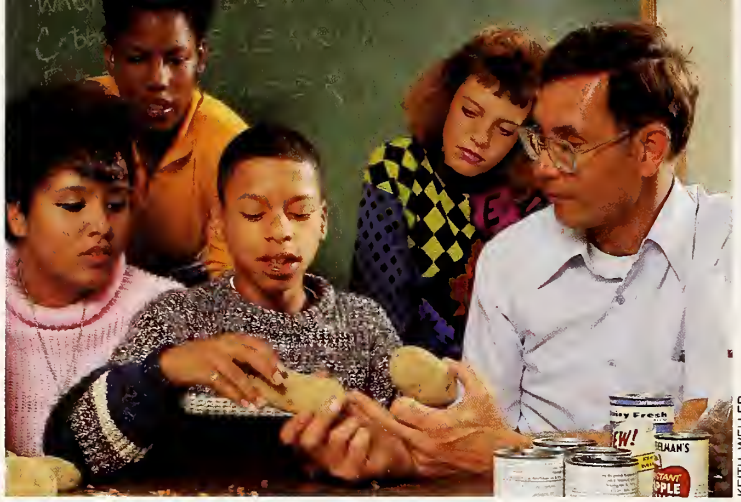
Peoria's TSTM club is open to 7th through 12th grade students enrolled in English, math, or science, who maintain at least a B grade average. Members pay $1 a month club dues.

Teachers, counselors, managers, and scientists offer club members help in selecting high school courses, career counseling, and tutoring. Through the summer job program, members get first-hand experience in the fields of engineering, mathematics, and science. Scholarships are also available for TSTM participants.

The community benefits too. TSTM members tutor at inner city schools and judge at local science fairs and exhibits.

Continued success of TSTM clubs depends on participation and support of parents, including mothers and fathers of current and past TSTM club members.

NRRC director Bert Princen serves as a member of the TSTM advisory committee, made up of local educators, scientists, technicians, parents, and representatives of business, industry and government.—By **Linda Cooke,** ARS. ◆



KEITH WELLER

ARS volunteer Michael Kozemple tells students from the Jones and Stetson Alternative Schools about processing farm commodities into food. (K-3414-1)

POTATO CHIPS

Surprise a teenager! Explain how chips are made.

Two years ago, few if any students at a Philadelphia inner-city junior high school knew—or even cared—how potato chips are made.

These munchies, after all, seemed to grow on racks in a grocery store, bagged in plastic, and ready to eat. The thought never crossed their minds that something called chemical engineering played a key role in turning raw spuds into wild-ranch-flavor chips.

But an agreement between the Agricultural Research Service and the School District of Philadelphia has altered that perception for a few disadvantaged students. The result? Science that's taken a leap from the textbook into the reality of teenagers.

Scientists at ARS' Eastern Regional Research Center in Philadelphia are spending time this year explaining technical research such as potato processing in a way that students at Jones and Stetson Alternative Schools could enjoy.

They volunteered their time to teach seventh, eighth, and ninth graders as part of the "Adopt a School Program."

The program, now in its second year, has proved to be more than a learning tool for teaching science to children.

"The major objective is to try to get kids interested in science and engineering," says Michael Kurantz, a supervisory chemist in the Engineering Science Research unit. "These kids otherwise might not ever get to meet a scientist."

Kurantz coordinates the program with Frank Urbanski, an English teacher at Stetson, and Walter Montague, who teaches at Jones.

When, during a hunting trip in the Pocono Mountains in northeastern Pennsylvania, Kurantz and Urbanski cooked up the idea, the goal was to expose students to science before they reach high school.

Kurantz says students may be more willing to show an interest in science if given encouragement earlier.

However, the program goes beyond the classroom, says Urbanski. To many Jones and Stetson students, drugs and crime are an everyday part of their life.

"Our program shows students that there are other options," Urbanski says. "I may tell them that, but to have a scientist come in and say it is a bit different."

This year, Kurantz has planned at least one scientific demonstration per month for the inquisitive students. Last year, 14 ARS scientists from the Philadelphia center volunteered their time to offer seven scientific presentations to about 50 to 75 students.

"They asked quite a number of questions—they were not shy at all," Kurantz says of last year's program. "Their interest level was surprisingly high, even to the teachers that deal with them."

Kurantz says students were also treated to a "chemical magic show." ARS scientists demonstrated how various chemicals can change color and explained the chemistry of the phenomena.

One scientist brought in a computer and showed students how it can draw molecules, another scientist demonstrated through a videotape how living organisms are used in food processing, Kurantz says.

John P. Cherry, director of the Philadelphia center, says ARS' contribution to education at these early ages will hopefully interest students in science and math fields down the road.

"We're trying to catch kids in the molding stages so they will have a better understanding of science," Cherry says. "Even if just one of those students chooses a career in science, we have achieved something."—By **Bruce Kinzel**, ARS. ◆

SOIL...SOME CALL IT DIRT

Kids in Pendleton, Oregon, grow up "surrounded by a great sea of wheat," says ARS researcher Elizabeth L. Klepper. "But most of them have never really looked closely at a wheat plant and don't really know much about how it makes grain."

That's why Klepper, along with all of the scientists and most of the technicians at ARS' Columbia Plateau Conservation Research Center in Pendleton, opened the doors of their laboratories to sixth through twelfth graders from neighboring schools.

Through the "Saturday Academy" of the Umatilla Education Service District, students can sign up for either or both of two $25 courses Klepper and colleagues designed especially for them.

One is an overview "introducing the kids to the idea of research, telling them why we pay people to do it and what it's worth," says Klepper, a plant physiologist. That class, held for the first time on four consecutive Saturday mornings in the spring of 1988, focuses on plant research.

A companion series in the fall, "Soil...Some Call it Dirt," offers kids a chance to run their own soil fertility experiments in the lab and to troop through fallow wheatfields with a researcher, learning about the structure and richness of the region's silt loam soils.

"I enjoy teaching and I enjoy spreading my ideas into other people's minds, watching them understand something fairly complicated," says Klepper.

In labs or outdoors, most classwork revolves around the center scientists' own assignments, which are to learn exactly how wheat plants develop and to find new tactics for protecting the region's tremendously productive yet highly erodible soils.

Klepper, for example, tells her students about PLANTEMP, the computer program she and colleague Ronald W. Rickman wrote so growers could predict, with the help of weather data, how quickly their winter wheat will grow. The Soil Conservation Service, USDA, now uses the software to help farmers minimize erosion.

After organizing the first Saturday Academy courses at the Center, Klepper has since delegated the job to staffers like soil microbiologist Harold P. Collins and soil scientist Joseph L. Pikul, Jr.

For one experiment, Collins has students plant seeds in pots filled with sand, ordinary soil, or fertilizer-enriched soil.

On subsequent Saturdays, the class takes seedlings out of the lab's climate-controlled "growth chambers" to check each plant's progress.

"The seeds in the sand will germinate and start growing but will eventually turn yellow and die because they aren't getting any nitrogen," says Collins. The take-home lesson is that plants, like people, need a balance of nutrients.

Like his students, Collins thinks this sort of hands-on experiment is better than having the class "just sit and look at a bunch of slides."

Colleague Pikul teaches students to make a cheap but effective thermocouple—a simple twist of two wires that, when hooked to a voltage meter, measures changes in soil temperature. In harvested wheatfields, students use the crude devices to log temperatures of soils covered with different amounts of wheat straw, deliberately left behind to protect the erosion-prone soil.

Seedbed temperature affects seedling success, explains Pikul, which is why he gauges soil temperatures for his own experiments with straw layers.

For Pikul, the Saturday Academy has meant missing time with his family on four Saturdays in a row and getting even further behind in remodeling his house. "But it's worth it," he says, "if you see the enthusiasm when students understand what you're saying."

Pendleton High School sophomores Robert D. Roselle, Jill M. Pambrun, and Marty J. Campbell were classmates for the ARS course in spring 1989.

Roselle signed up because his vocational agriculture instructor offered him extra credit. "I might go into ranching, so I was sort of interested in the course anyway," he says.

As with most students, he liked the mini-experiments the best: He remembers dissecting a head of wheat to find the tiny kernel developing within the flower; transferring pollen from one plant to another—"just like wheat breeders do"; and looking under a microscope at bacteria from his hands, for the lesson on helpful and harmful soil bacteria. "I thought the course turned out really well," he says, "and it was a lot of fun."

For Marty Campbell, growing bacteria in laboratory dishes and learning about plant diseases were the best parts of class. "It's like we were in college," says Campbell, "and weren't just there for extra credit."

Campbell lives in town, unlike most of his classmates who live on farms. "But," he notes, "things are different since I've taken the class. Now I know what the farm kids are talking about." He didn't like having to get up early on Saturday morning (class starts at 9 a.m.). "But it wasn't too bad once you got there," he says, "because you have such a good time."—By **Marcia Wood,** ARS. ◆

From Coast to Coast, Showing Their Class in Science

"It's a great chance for ARS to influence the way science is taught in the community." That's how **Richard T. Mayer,** ARS location coordinator in **Orlando, Florida,** feels about his lab's outreach program to Orange County science teachers. In the program, teachers work in labs, greenhouses, and field plots during summer to gain credit toward maintaining their teaching certificates. **Jo J. Bennett,** who teaches sciences at Winter Park Ninth Grade Center, says she's using her new knowledge of subjects like plant protein synthesis to help her students answer that perennial question, "Why do we have to learn this?"

Research apprentice **Jennifer Brockway,** a junior and honor student at Old Town High School in Maine, was "overwhelmed and apprehensive at first." But her work last summer with ARS researchers in **Orono, Maine,** will help them iron out the kinks in white lupine. This grain crop could give northeastern farmers something they need but don't have—a locally grown high-protein livestock and poultry feed. Trouble is, the plant's germination and maturation are quirky. Under guidance from research leader **William Clapham,** Brockway tested many pre-plant treatments to "prime" the seed so it will germinate quickly and the crop will mature all at once. The work "opened my eyes to what science is, that it's not just a textbook," says Brockway, who's leaning toward a research career in marine biology.

"When teachers see firsthand the intensity and depth of ARS research, it helps them impart their own enthusiasm to their students," says **Dick Hardee,** who heads the Field Crop Insect Management lab in **Stoneville, Mississippi. Roy Riley** , who teaches chemistry and physics at Greenville High School, says his students are chasing the "whys" of data he and Hawkins collected last summer on the spread of cotton aphids and their infection by a parasitic wasp.

John Hawkins, a chemistry teacher at T. L. Weston High School in Greenville, says the teachers reaped a big new crop of ideas for science fair projects. Researchers are helping students plan and conduct the projects. Plus, the aphid studies could wind up helping area farmers use chemicals and biological control agents more efficiently to combat the pest.

A historically black university in **Greensboro, North Carolina,** could become a center for protecting southern Piedmont soils from erosion. That's because a fledgling ARS-supported research program at North Carolina A&T University is helping several grad students and undergrads equip themselves to tackle the demands of scientific research. Guided by project coordinator **Joe Bradford** of ARS and postdoc researcher **Charles Raczkowski** from North Carolina State University in Raleigh, the students are validating a new research model that predicts soil erosion by water. Last August researchers nationwide began using the model, says Bradford, a soil scientist at the ARS National Soil Erosion Research Laboratory in **West Lafayette, Indiana.** Ultimately, he adds, farmers will rely on the predictions to plan soil-saving farming systems and USDA will use the predictions to determine eligibility for many farm programs. A&T plant science major **Melvin Tucker** analyzes soil and water samples for the erosion project. "It's valuable hands-on experience I wouldn't get otherwise," he says.

"The researchers' willingness to listen to new ideas gave me a go-for-it mentality," **Elisa Beth Haransky** says of her ARS scientist mentors. Haransky, as a parttime employee at the **Beltsville, Maryland,** Insect Pathology Laboratory in the early 1980's, came up with the concept on which ARS scientists built a new I.D. test for strains of a biocontrol bacterium. The test helped them identify 83 new types of *Bacillus thuringiensis,* and two firms have licenses to produce some of them as commercial biocontrols. Bitten by the research bug at ARS, Haransky—besides her private optometry practice—conducts research on children's vision for George Washington University and the District of Columbia's school system.

The intricate tools of gene engineering—like DNA extractions and immunoassays—are all in a day's work for two dozen or so undergrads from the Berkeley campus of the University of California. Working part-time at the UC-ARS Plant Gene Expression Center in **Albany, California**, "they are giving first-class support to our scientists," says center director **Gerald G. Still.** Former part-timer **Pamela J. Petersen** has worked full time at the center since receiving her genetics degree from UCB in May. With ARS geneticist **Sarah C. Hake,** Petersen is investigating an odd but natural mutation that stunts corn plants and causes

bumps and fingerlike projections on leaves. "Figuring out the genetic mechanisms behind this," says Hake, "should give us a better idea of how genes control a plant's normal growth and how we can change the plant's development with genetic engineering." Petersen plans to continue with genetic studies in medical school. "After working as a waitress, hostess, receptionist, bookkeeper, sales associate, and salmon-roe packer to put myself through school," she says, "it was great to finally land a job relating to my academic interests."

A long-time love of gardening—and the waning appeal of being a dental assistant—led **Carolyn Shipley Jaussi** to a career switch to benefit herself and her five children. In November 1987, as a Utah State University sophomore, Jaussi landed a part-time job—through the cooperative education program—as a biologist with the Forage and Range Research Laboratory in **Logan, Utah.** Her work with tissue culture of wheatgrass relatives could eventually pay off in new, drought-resistant forages. "I had pictured myself working in a nursery or teaching, but once I had my teeth into research I was fascinated by it," she says. Jaussi is now a full-time ARS support scientist and grad student seeking a masters degree.—By **Jim DeQuattro,** ARS. ◆

MY SUMMERS WITH SCIENCE:
A Former Apprentice Looks Back

When S. Malia Fullerton was 18, she landed her first "real" job—working in the Panaewa rain forest just outside Hilo, Hawaii.

At 22, Malia is now a scholastic success: a Rhodes scholar, she's starting 2 years of study—all expenses paid—at Oxford University. When she returns from Britain, a place will be held for her at the University of California at San Francisco. She hopes to earn both a Ph.D. and an M.D. there.

Still modest in the face of these and other honors, Fullerton remembers hard work, fun times, and the "feeling of being important" as a research apprentice in the Agricultural Research Service.

She spent two summers and one Christmas break working for research food technologist Harvey T. Chan at the Tropical Fruit and Vegetable Research Laboratory's Hilo site.

Fullerton, one of nine apprentices who have worked at the Hilo laboratory, helped test a fungus which at that time was thought to be a promising new lure for detecting and trapping the Mediterranean fruit fly. That insect is a pest of more than 200 different kinds of fruits and vegetables.

She also identified bacteria and fungi that attack papaya, one of Hawaii's most important crops.

"One of my high school teachers told me about the apprenticeship program and encouraged me to apply," says Fullerton. "I was so glad to get a job in a laboratory setting and not in an office or fast food chain."

The Tropical Fruit and Vegetable Research Laboratory at Hilo is located just off a narrow, generously potholed road that starts near an anthurium farm (raises tropical flowers) and ends at a prison.

The research site is a cluster of small, single-story buildings. Most have the typical tropical construction—steel sides and a corrugated roof designed to withstand heat, humidity, and the Big Island's yearly 150 inches of rain. Inside, most of the laboratories are cool, comfortable, and well stocked.

Fullerton's supervisor was Kate A. Nishijima, a young plant pathologist with the Commodity Treatment Research unit. "She knew that I wanted to be the big scientist," laughs Fullerton. "Sure, I had to keep the labware clean. But she also let me run my own experiments and make my own records of the results."

"Sometimes I'd help the quality-control technicians," Fullerton recalls. "We'd go around to the packinghouses and get bins full of papayas and then bring them back and sit on the porch behind the lab, cutting them in half and grading them. We'd cut 500 papayas a day. I know a lot of people who think papaya is a delicacy. But as for me, I never want to eat another one."

Whether she was grading packinghouse papayas or trying to identify bacteria, Fullerton says she always felt her ideas were wanted.

"Now that I've been in other labs, I know that isn't always the case. Sometimes people want you to just get the information they need and then hand it over to them. But in the lab at Hilo, I always felt that what I said and did were important."—By **Marcia Wood,** ARS. ◆

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